

RESTORING NATURAL CAVE DRAINAGES

STUDY/IMPLEMENTATION PLAN

TIMPANOGOS CAVE NATIONAL MONUMENT

Project PMIS # - 86657

GPRA Goal Ia09B – Cave Resources

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Abstract

A lighted, paved trail allowing over 80,000 people/year to tour Timpanogos Cave has significantly modified the natural drainage of water through the cave. Where the drainages cross the cave trail, the visitors' feet spread the mud coating the surrounding formations and discoloring the cave's pure water supplies. This introduced mud causes the formations to lose their astounding color, it decreases the water quality, and it provides food sources to sustain non-cave adapted species. The natural processes can be restored by minimizing the cave trail's interaction with the water flow paths and creating maintainable catchments to keep the imported debris from escaping the trail.

INTRODUCTION

Problem Statement

A lighted, paved trail has been developed allowing over 80,000 people/year to be awed by many delicate and colorful formations of Timpanogos Cave. This trail has significantly modified the natural drainage of water through the cave. The trail diverts the water flow changing the natural flow paths. Where the drainages cross the cave trail, the visitors' feet spread the mud coating the surrounding formations and discoloring the cave's pure water supplies. This introduced mud causes the formations to lose their astounding color, it decreases the water quality, and it provides food sources to sustain non-cave adapted species. The natural processes can be restored by minimizing the cave trail's interaction with the water flow paths and creating maintainable catchments to keep the imported debris from escaping the trail.

There are three locations of concern: the catwalk over Middle Cave Lake, the stairs near Salt and Pepper Shaker Formation, and the bridge over the Living Color Room. These locations are introduced amazing amounts of outside debris to the cave. There are many visual effects to cave's formations; however, the effects to the cave's ecology are hypothesized and need further study.

A grated catwalk crosses over an 80-ft long by 5-ft wide portion of the lake. Underneath the catwalk, up to 3ft of sediment has accumulated over the flowstone lined lake! At last year an effort to clean the lake had begun. Only 10ft of lake was cleaned with a four person crew. A full gallon baggie of just lint from visitor's clothes and about 50ft³ of mud and gravel was removed! Sediment catchments and a larger cleaned effort are needed.

A large 30-ft long and 20-ft high flowstone formation, the Cascade of Energy, continually flows with water that has percolated from the surface. Narrow stairs navigates the tours passed this formation. The runoff from this formation cascades down the stairs and collects debris from the tours. The stairs become a slippery mess. One day 3 Rangers that tour the cave 5 times/day reported to have slipped on the stairs. In the downslope side, a 1950s trail mesh has been found buried up to foot in sediment. This

accumulation covers an area about 40-ft long by 20-ft wide and then drops off into the cave's most decorated room, the Chimes Chamber. The trail needs to be redesigned so water will not flow on the trail and the sediment can be captured.

The ponded water on bridge across the Living Room splashes off the trail covering the surrounding areas with mud. A distinctive mud line is present about 2 ft above the trail. Below this line everything is coated with mud. Small 2-inch wide cuts were made into the trail to drainage water cross the trail. This drainage cut never flowed, but rather clogged with mud. Larger scale effort is needed to prevent standing water on this area.

The trail's impact to natural drainage through the cave can be successfully mitigated. The accumulated sediment can be removed. The effects to the cave's formations and ecology can be restored. However, without action, the irreversible impacts to cave ecology and value of the resource will steadily increase.

BACKGROUND

Timpanogos Cave is protected under two acts of legislation. President Harding's Proclamation that created Timpanogos Cave National Monument states "Timpanogos Cave ... is of unusual scientific interest and importance, and it appears that the public interests will be promoted by reserving this cave..." The Federal Cave Protection Act of 1988 states that "...caves on Federal lands are an invaluable and irreplaceable part of the Nation's natural heritage. The purposes of this act are to secure, protect, and preserve significant caves on Federal lands for the perpetual use, enjoyment, and benefit of all people..." The natural resources of Timpanogos Cave are directly being impacted and will continue to be impacted without action.

Every passing visitor slowly adds to the degradation of Timpanogos Cave's resources. Formations are slowly being coated with mud that can create acidic conditions that can eat away at the formations. Where the water is heavily depositing formations, the mud can be coated with thin layers of calcite making its removal without damage impossible. The ecosystem's health is being threatened by decreasing water quality and ability of hosting exotic cave species. Without action, the unique formations and the ecosystem that could thousands of years will be irreversibly damaged.

SPECIFIC OBJECTIVES TO BE ADDRESSED

The objectives of this project are as follows:

- To restore the natural drainage paths by restructuring how the cave trail interacts with the cave's drainages
- To remove accumulated sediments and other debris using established cave cleaning methods
- To identify detrimental effects (loss of ecosystem health, impacts to cave formations, etc.) that have occurred due to years of lower water quality

- To evaluate needs for additional action or studies to further protect cave resources

ENVIRONMENTAL PLANNING

CatX exclusion ...

PRINCIPAL PROJECT MANAGERS

The project leader, Jon Jasper, has a long background in Cave Management working with Lehman Caves, Mammoth Cave, and now Timpanogos Cave. The monument has been keeping him up-to-date by sending him to the training such as the biannual National Cave Management Symposium and the annual National Speleological Society (NSS) Conventions. He is knowledgeable of the other possibilities and techniques and believes this is the best course of action. The problem, objective, and needed products are as defined as well as the present knowledge base allows.

STUDY/IMPLEMENTATION PLAN

Approach and Methods

Removing the problem

The solution is to isolate the trail from the cave's drainages and add sediment catchments. For catwalk across Middle Cave Lake, a sediment catchment made of PCV will be added to the existing structure and the new grating that can be quickly removed to clean out the catchment will be installed. At the Cascade of Energy where the trail is wall to wall, the trail will be removed and a new raised trail that water can flow under will be constructed. The stairs at the Cascade of Energy will be modified so the water will not flow over it. The concrete bridge over the Living Color Room will have a grated top constructed to remove water off the trail and to catch sediment. The modifications should prevent the interaction of the trail with cave drainages and sediment.

Evaluating the solution

The applied solutions will be evaluated by studying if the water flow is still diverted by trail and measuring the amount of sediment leaving the trail before and after the modifications. When water flow peaks in the cave the structures will be visually evaluated to assess how the trail interacts with the cave's drainage. The amount of sediment accumulating adjacent to the trail will be measured by setting out petri dishes and weighting the change. Strips of cloth will also be placed around affected areas before and after the modifications. The clothes will absorb mud and water visually showing

how the areas on being impacted by mud leaving the trail. As the cave is restored, the cleaned areas will be photomonitoring to study whether they are still being impacted.

Restoring the cave

The majority of the projects time will be spent restoring the cave resources. The introduced sediment that has accumulated over the 80 years of tours will be hauled out of the cave and the underlying surface will either be brushed or sprayed clean using a backpack sprayer filled with water from the cave. Special considerations will be made for cultural and archeological remains that may be found. Precaution of digging through natural sediments deposits or harming underlying formations will be taken. Special considerations will be made for cultural and archeological remains that may be found. Precaution of digging through natural sediments deposits or harming underlying formations will be taken.

Monitoring water quality

Additional funding is being sought to establish a water quality monitoring program for the cave. This project will involve sending water samples to EPA approved lab to look for possible indicators of decreasing water quality that is threaten the cave's ecosystem. DNA fingerprinting technique is also being incorporated to study microbial diversity associated with the water quality. These studies will be used to study the affects of this project on water quality and biologic diversity.

TASKS, ORGANIZATIONS, AND SCHEDULE

The NRPC project coordinator is Ron Kerbo. The project budgeting, personnel hiring, and ultimate supervision will be performed by the Park's Chief Ranger, Mike Gosse. The project will be headed by year Jon Jasper, a TERM GS-07 Resource Management Specialist. To perform the trail alterations, 3-4 seasonals will be hired. Due to end of the RM Specialist's appointment, the final reporting will fall under the responsibility of the most capable RM seasonal.

2003

Planning, equipment purchasing, and hiring – January to April

Quarterly water samples taken – Jan, March, June, Sept

Construction and remediation – April to May

Cave Mgt Symposium presentation - October

Additional remediation and cave restoration – September to November

Vehicle rental – May through October

2004

Cave restoration – May, Sept, October, November

Quarterly water samples taken – Jan, March, June, Sept

2005

Final Report Writing – March to May

Quarterly water samples taken – Jan, March, June, Sept

Additional Cave restoration – May, September

Review- May to July

Publication - September

DELIVERABLES AND REPORTING

Final completion reports

This project will have great transferability with other 11 parks that have developed trails through caves. All of these cave parks have conflicts between the trail development and natural water flow through the cave. This project will add to this knowledge base of how to define and mitigate these problems. This project will implement unique techniques of monitoring and restoration methods that will be published in the NPS Caves and Karst publication. The project will be presented at the 2004 National Cave Management Symposium.

Annual accomplishment Reporting

An annual report will be submitted by October 30 for every year that project is conducted. The accomplishment report will contain an abstract not to 300 words in length as a stand-alone document. This abstract will then be entered into the “Accomplishments” field of the project’s PMIS.

Quality assurance quality control, and data quality objectives

Water quality monitoring will occur during the duration of the project. Water quality parameters will be reached using an EPA approved lab. DNA fingerprinting will be used to establish microbial diversity. DNA fingerprint of samples will be performed by Biology Department at Western Kentucky University. Both these labs will be required to provide their operating procedures, detection limits, and use of multiple line of evidence.

BUDGET COST

FY2003 - Begin modifications to trail diversions and sedimentation problems	
1 GS-7 RM Specialist for 12 pp @ \$1,365/pp	\$ 16,380
2 GS-5 Biotech for 12 pp @ \$1,071/pp	\$ 25,704

1 GW-5 Laborer for 6 pp @ \$1,134/pp	\$ 6,804
Modifications to Middle Cave Lake's Catwalk	\$ 1,200
Modifications to the Living Color Room bridge	\$ 1,500
Modifications to stairs near Salt & Pepper Shaker	\$ 2,500
Water quality monitoring	\$ 10,000
GSA Vehicle – rental and mileage for 6 months	\$ 3,650
Training and Presentations at Cave Management Symposium for 3	\$ 3,600
FY2003 Total	\$67,738.00

FY2004 -	
Evaluate modifications and begin cave cleaning and water quality restoration	
1 GS-7 RM Specialist for 12 pp @ \$1,433/pp	\$ 17,199
2 GS-5 Biotech for 12 pp @ \$1,124/pp	\$ 26,990
1 GW-5 Laborer for 3 pp @ \$1,190/pp	\$ 3,572
Additional Modifications and Cave Cleaning Equipment	\$ 1,000
Water quality monitoring	\$ 10,000
GSA Vehicle – rental and mileage for 6 months	\$ 3,650
FY2004 Total	\$66,011.00

FY2005 -	
Finish cave and water quality restoration	
1 GS-7 RM Specialist for 12 pp @ \$1,500/pp	\$ 18,018
2 GS-5 Biotechs for 12 pp @ \$1,180/pp	\$ 28,320
1 GW-05 Laborer for 2 pp @ \$1,250/pp	\$ 2,500
Water quality monitoring	\$ 8,000
Publication costs	\$ 300
GSA Vehicle – rental and mileage for 6 months	\$ 3,650
FY2005 Total	\$60,788.00

Project Total	\$ 194,537
41 % Contributions (RM Specialist GS-7, water quality monitoring)	- \$ 79,597
Total Requested	\$ 114,940